AN EVALUATION OF LUCERNE AND CLOVER CROPS FOR FINISHING WEANED LAMBS

K. T. Jagusch; P. V. Rattray; G. W. Winn
Ruakura Agricultural Research Centre, Hamilton
New Zealand

ABSTRACT

Claims for the superior growth rates of lambs given legumes compared with conventional pastures were evaluated in light of recent work showing precise curvilnear relationships between herbage allowance (kg DM offered/lamb/day) and performance (g weight gain/day). At low allowances legume-fed lambs grew markedly faster than those given ryegrass pastures due to animals eating more legume. However as allowance increased the margins in performance diminished as lambs fed ryegrass-based pastures increased voluntary intake in contrast to legume-fed lambs. Optimum allowances for near maximum gains were therefore lower for legume-fed lambs. Thus the swinging of high producing ryegrass - white clover pastures to clover dominance by hard-grazing paddocks prior to weaning should produce the most economical gains particularly in areas where lucerne, which also produces as well as ryegrass pastures, cannot be grown.

INTRODUCTION

The superior growth-promoting value of legumes for sheep compared with ryegrass-based pastures, including pure ryegrass, has been shown in a number of field trials (McLean *et al.*, 1962; Rae *et al.*, 1965; McLean *et al*, 1965; Hight and Sinclair, 1965; Jagusch *et al.*, 1971; Hight *et al.*, 1972). Although still favouring the legume, differences have not been so marked in box-feeding trials indoors (Joyce and Newth, 1967; Rattray and Joyce, 1969; 1974; Fennessy *et al.*, 1972) where measured intakes have been low compared with those taken in the field (Jagusch and Coop, 1971).

Milford and Minson (1966) and Treacher (1970) maintained that the true nutritional value of different pasture species would only be expressed if utilization per grazing was low and Jagusch *et al.* (1979a) obtained marked depressions in lamb growth rate when the animals were forced to eat more pasture at each grazing. The latter obtained a 'Mitscherlich' relationship between growth rate and herbage allowance of reygrass-white clover, which for all practical purposes was stable for a wide range of conditions (year, digestibility, yield (kg DM/ha), short and long pasture representing animal accessibility differences to 1.5-4.5 t green DM/ha).

If indeed all pasture and crop species behaved similarly, namely reduced performance as feed utilisation is increased and/or post grazing residues are reduced, then comparisons should be made over a range of allowances. In light of these findings the use of legumes for finishing weaned lambs has been reassessed in trials at Wairakei Research Station and at Ruakura. Preliminary results from both environments have been reported by Jagusch *et al.*, (1979b). The present paper describes 2 trials comparing legume crops with ryegrass pastures conducted at Ruakura. Ruakura.

MATERIALS AND METHODS

Model

In assessing differences in the liveweight gain/allowance relationship for different feeds it is best (for reasons of improved statistical power and simplicity of explanation) if those differences can be expressed by changes of a single model parameter. The following development results in models which form a subclass of the Mitscherlich family of curves.

Let e denote energy content of a feed allowance and let g be weight gain. Then due to gut fill and metabolic restrictions on the amount of energy consumed by an animal there must be some upper limit, g_m, to the weight gain. To achieve an increase in weight gain from some g to g + $\triangle$g energy must increase by an amount $\triangle$e, and it might be assumed that $\triangle$g will also depend on the difference between g and g_m; so we make the explicit assumption that:

$$\triangle g \ \alpha \ (g_m - g) \ \triangle e \qquad (1)$$

To convert this relationship from energy to feed allowance we must take the varying efficiencies of different feeds into account; these will be reflected in the different values for g_m so it is assumed that:

$$\triangle e \ \alpha \ g_m \ \triangle a \qquad (2)$$

where a is feed allowance.

$$\text{Thus } \triangle g \ \alpha \ g_m \ (g_m - g) \ \triangle a \ ; \qquad (3)$$

on re-expressing (3) in terms of differentials

$$\frac{dg}{da} = p_3 \ g_m \ (g_m - g) \qquad (4)$$

where p_3 is the constant of proportionality.

Solving (4) we obtain:

$$g = g_m \ (1 - \exp (p_2 - p_3 \ g_m \ a) \ ) \qquad (5)$$

In this last equation the constants p_2 and p_3 are related to the animal (they are a scale and shape parameter respectively) whereas g_m is a measure of feed quality and is the only one which will change when the feed is changed. The parameters of equation

(5) were fitted using the non-linear least squares alogarithm of Ralston and Jenurich (1978) on a Radio Shack TRS-80 micro-computer.

Allowance, and also intake, was measured using the pasture cutting technique (exclosure cages used during grazing) described by Jagusch *et al.* (1978).

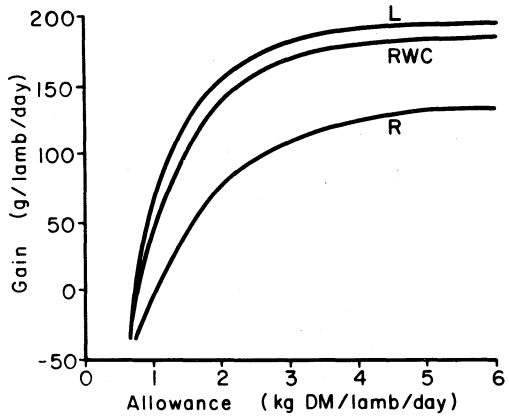
Trial 1

This trial was conducted with 15 groups of Suffolk x Coopworth lambs (n = 11/group) weighing 20 kg initially. They were fed either lucerne (L), ryegrass-white clover (RWC) containing about 15% white clover, or ryegrass (R), for 4 weeks with grazing intervals of 2 weeks during December, 1978. Each psture (3-4 t DM/ha pregrazing) was offered at one of five allowances (range 0.9 - 7.9 kg DM/lamb/day) although the aim was to achieve a range of 1-6 kg DM/lamb/day.

Trial 2

Trial 2 was conducted with 25 groups of 22kg liveweight, Suffolk x Coopworth lambs (n = 10/group) fed either white clover (WC), red clover (RC), L, RWC, or R for 4 weeks with grazing intervals of 2 weeks during January-February 1979. Each pasture species (3-5 t DM/ha pregrazing) was offered at one of five allowances (range 0.9 - 7.7 kg DM/lamb/day). Lack of available feed to provide a fresh 'break' after 2 weeks for lambs given the two lowest and the highest allowance of ryegrass, meant only 4 pasture species could be compared.

Figure 1: Relationships between herbage allowance of L, RWC, and R and lamb growth rate in Trial 1.



RESULTS

The fitted relationships between growth rate and allowance calculated from the above model for lambs in trial 1 are given in Fig. 1. L lambs performed slightly better than RWC and both grew significantly faster than those given R alone ($P < 0.025$). Near maximum gains (g_m) were 189, 181, and 134 g/lamb/day representing practical allowances of 4, 4, and 5.5kg DM/lamb/day for L, RWC, and R lambs respectively.

Lamb intakes are given in Table 1. It can be seen that the rate of increase in intake with increasing allowance was highest for R lambs and least for L.

TABLE 1: Pasture intake (kg DM/day) for lambs in Trial 1.

Herbage Allowance (kg DM/lamb /day)	Lucerne	Ryegrass - White Clover	Ryegrass
1.2	0.9	0.7	0.5
2.4	1.1	0.7	0.8
3.3	0.9	0.6	0.9
5.0	1.3	0.8	1.6
7.0	1.0	1.1	1.5

The fitted curves for lambs in trial 2, again calculated from the model, for growth responses to WC, RC, L, and RWC together with the 2 valid plots for R are given in Figure 2. WC lambs grew faster than those fed RC which in turn were substantially better than both L and RWC lambs ($p < 0.005$). Near maximum gains (g_m) were 201, 179, 136, and 135 g/lamb/day representing practical allowances of 2.5,3.0, 3.5 and 3.5 kg DM/lamb/day for WC, RC, L, and RWC lambs respectively. Some reduction in liveweight gain associated with season is apparent with L, RWC and R lambs when Fig. 1 and 2 are compared.

Figure 2: Relationship between herbage allowance of WC, RC, L, RWC and R and lamb growth rate in Trial 2.

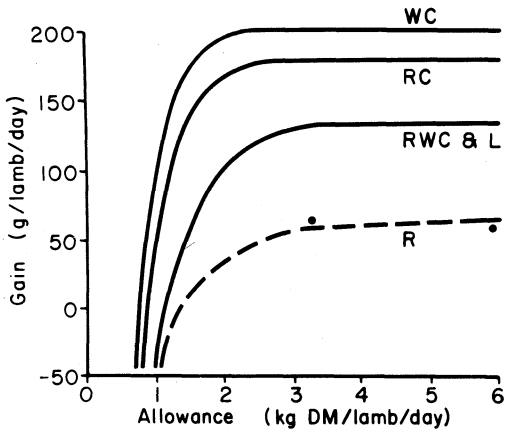


Table 2 shows intakes of legume-fed lambs tend to level off more quickly at the higher allowances compared with RWC as happened in Trial 1.

TABLE 2: Pasture intake (kg DM/day) for lambs in Trial 2.

Herbage Allowance (kg DM/ lamb/day	White Clover	Red Clover	Lucerne	Ryegrass-White Clover	Ryegrass
1.1	1.0	0.7	0.6	0.7	–
2.2	0.6	0.8	0.9	1.1	–
3.3	0.9	0.8	1.1	1.0	0.8
5.0	1.6	1.1	0.9	1.5	1.1
6.5	1.0	0.7	0.9	2.1	–

TABLE 3: Relative costs ($/ha/annum) for different pasture species.

	White Clover	Red Clover	Lucerne	Ryegrass White Clover
Stand Life	5 year	5 year	8 year	Permanent
Establishment Costs	47	59	32	–
Maintenance	142	142	50	28

Table 3 gives the relative costs of pure species stands compared with a permanent sward of ryegrass-white clover. The high maintenance costs for clovers reflects the necessity for weed control, in particular grasses, docks, and thistles. It should also be noted that clover annual yields are lower than either L or RWC swards and that L grown in certain areas with free draining soils compares favourably with ryegrass-white clover in terms of costs per unit of lamb growth (Jagusch *et al.*, 1979b).

Table 4 gives mean values for the liveweight gains of 4 groups of lambs grazing ryegrass-white clover swards containing more than 50% white clover. Clover dominance was achieved by grazing the swards heavily when paddocks were set stocked for silage feeding experiments or used as 'run off' paddocks in field crop studies. Growth rates recorded were similar to those found with WC and RC lambs in the present trials suggesting that most economical finishing strategy is to swing certain RWC paddocks to clover dominance by hard grazing before weaning.

TABLE 4: Growth of finishing lambs on clover dominant ryegrass pastures.

Grazing Management	Pasture Allowance (kg DM/lamb/day)	Liveweight Gain (g/lamb/day)
Continuous*	4.1	236
Continuous*	2.9	177
Rotational[1]	3.2	184
Rotational[1]	2.7	153

* 4 week allocation [1] 1 week allocation

DISCUSSION

The liveweight/allowance relationships given in this paper show that accessibility and selection and degree of utilisation are potent factors affecting performance with all pasture species. They show that non-specific field trials can be grossly misleading if the allowance component is not stable. From a feed budgeting, viewpoint the relationships represent the nutritional requirements of the lambs at pasture and would enable the farmer to calculate how long a paddock would last finishing lambs, what performance he can expect from a given volume of feed present, and what prior planning in a given season has to be done to ensure feed is effectively allocated and utilised. The cleaning up of pastures is done with stock at maintenance.

At allowances optimum for each species the growth promoting value of clovers and to a lesser extent lucerne appears to be due to metabolic factors associated with the intrinsic nutritional value of the feeds rather than intake when compared with ryegrass based pasture. Tender tissues, rapid comminution in the rumen, and intense rumen fermentation resulting in fast rates of passage and increased energy and N digestion in the post rumen gut, together with volatile fatty acid production favouring a glucogenic response in the animal (McLean *et al.*, 1962; Ulyatt, 1971; Ulyatt and McCrae, 1971) seem to be involved in the legume response which produces greater efficiency of utilisation of absorbed nutrients (Rattray and Joyce, 1974). For these reasons clovers have been recommended as finishing crops (Ulyatt, 1978). However, at the asymptote, ryegrass-white clover swards gave excellent results and it would appear that swinging such swards to clover dominance has the effect of pushing the dose-response curve into those areas occupied by the clover-based relationships. It would seem therefore that ryegrass based pastures have been penalised in the past because comparisons have not been made at an allowance giving lambs ample opportunity to select together with maintenance stock in the system for cleaning up residues. In practical terms, the maintenance and appropriate use of ryegrass-white clover swards for finishing lambs has obvious economies.

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